Fleischmann and Pons explain their breakthrough to a congressional committee. The punch line: a request for $25 million

COVER STORY

Fusion Illusion?

Two obscure chemists stir up a fascinating controversy in the lab, but new tests challenge their hopes of creating limitless energy

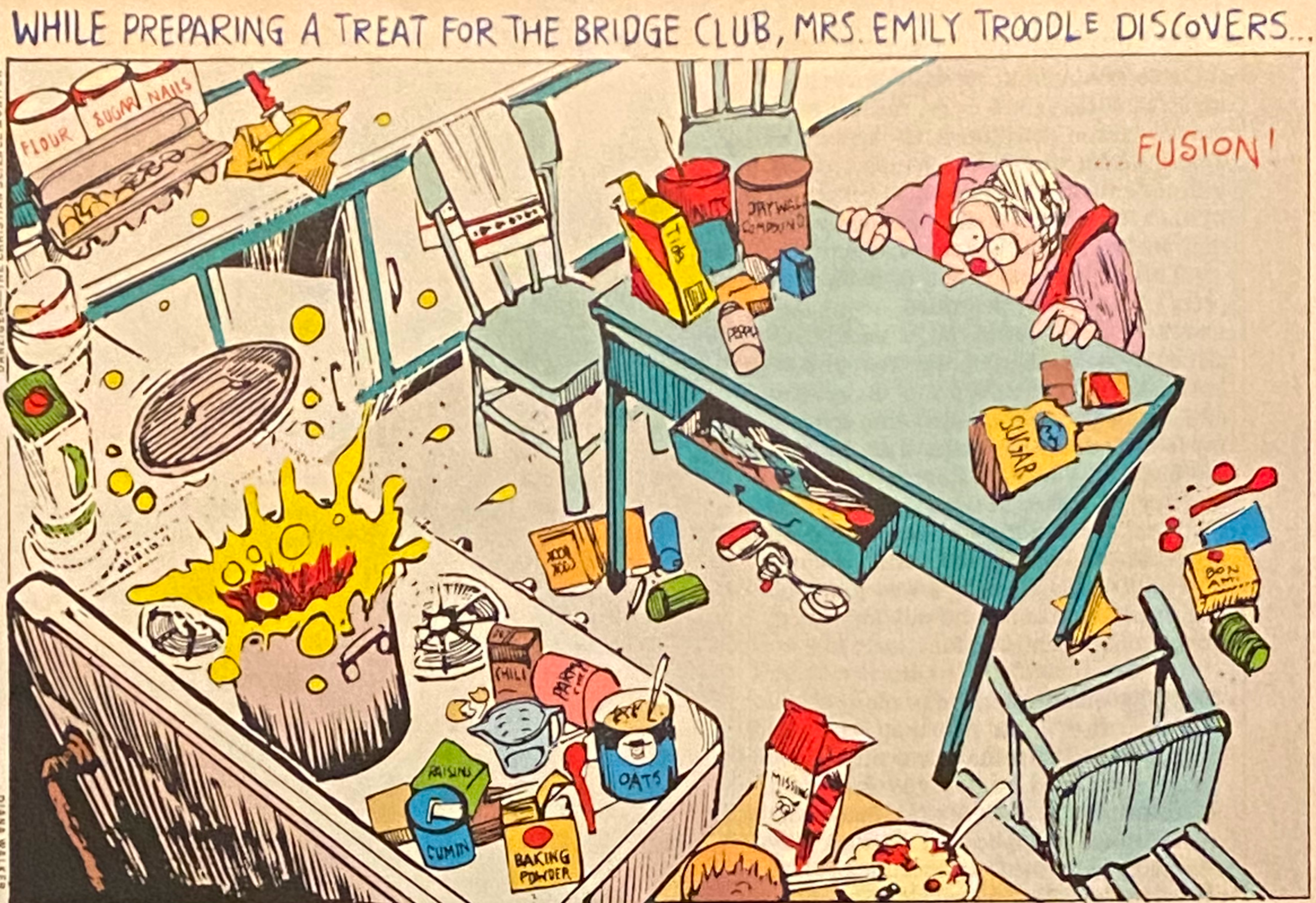
BY MICHAEL D. LEMONICK

Little more than a month ago, they were just two chemists, toiling in virtual anonymity. But B. Stanley Pons and Martin Fleischmann came last week to Washington as heroes, visionaries and scientific superstars. With a mob of reporters following along, the thermodynamic duo marched onto Capitol Hill to tell Congress how their simple tabletop experiment had generated fusion, the nuclear reaction that powers the sun. Displaying slides filled with complex equations, wielding electronic pointers and pulling a mockup of their apparatus from a plastic shopping bag, the bespectacled researchers mesmerized the members of the House Committee on Science, Space and Technology with an account of how their device produced more energy, in the form of heat, than it consumed. The politicians may have been baffled by the chemistry, but they had no trouble grasping the implications. It seemed that Pons, a professor at the University of Utah, and Fleischmann, of Britain's University of Southampton, might have pulled off a trick that has eluded some of the best minds in physics for nearly four decades. More important, they might have found a way to solve the world's energy problems for all time.

What would it take, they were asked, to make that dream a reality? Money from Congress, of course. University of Utah President Chase Peterson, who was right there at the scientists' side, suggested that $25 million would be a nice sum to help his school set up a fusion research center. Some of the Congressmen appeared eager to oblige. "Today," rhapsodized Robert Roe, a New Jersey Democrat, "we may be poised on the threshold of a new era. It is possible that we may be witnessing the cold-fusion revolution."

But Congress had better wait a while before it starts pouring taxpayers' money into Utah's test tubes. Even as Pons and Fleischmann stirred excitement on Capitol Hill, evidence was mounting that their form of fusion is probably an illusion. More and more scientists were openly scoffing at the chemists' claim that they

DIANA WALKER



DANZIGER—THE CHRISTIAN SCIENCE MONITOR

had caused deuterium ions, which are commonly found in seawater, to fuse to form helium, liberating large amounts of heat. Physicists have never been able to achieve such a sustained reaction, even briefly, without subjecting deuterium to the kind of extreme temperature and pressure found inside the sun.

While no one has proved conclusively that Pons and Fleischmann are wrong, it seems likely that they jumped to a hasty conclusion based on incomplete research. Scientists in Japan and Switzerland announced that their own tests had convinced them the original work was flawed. An attempt by the Harwell Laboratory in Britain to confirm the discovery has also produced nothing, even though Fleischmann himself checked the experiments.

None of the major national laboratories in the U.S. have obtained positive results either. This week data from one of the most comprehensive sets of experiments to date—a collaboration between Brookhaven National Laboratory and Yale University—will be presented at the spring meeting of the American Physical Society in Baltimore. The Brookhaven-Yale tests found no evidence of what Pons and Fleischmann saw. Brookhaven physicist Kelvin Lynn speculates that the heat produced may possibly be the result of some more conventional, though unexpected, chemical reaction. "It's quite interesting," he says, "to wonder how nature may have conspired to make them believe they had fusion."

Most damning of all is the editorial that appears in the current issue of the prestigious British journal *Nature*. The Pons-Fleischmann claim, writes editor John Maddox, "is literally unsupported by the evidence, could be an artifact [a spurious result unrelated to the phenomenon under investigation] and, given its improbability, is most likely to be one." Maddox noted that the team announced its results before performing even the most basic control experiments to verify the findings. That was an "astonishing oversight," wrote Maddox, "a glaring lapse from accepted practice."

Those are strong words, but Pons and Fleischmann are hanging tough behind their claim. Pons, in fact, says the experiments in his Utah lab have begun to produce increasing amounts of heat. And he has picked up a determined band of supporters. Robert Huggins, a respected materials scientist at Stanford, contends that he has also obtained excess heat in a series of similar experiments. Says Huggins: "The magnitudes of our observed effects are comparable to those reported earlier by Fleischmann and Pons, and lend strong support to the validity of their results."

Whether or not they turn out to be right, Pons and Fleischmann have pushed the entire scientific world into a frenzy. After the March 23 press conference in which the two chemists went public with their discovery, researchers around the globe immediately came down with fusion fever. Its symptoms were hyperactivity, insomnia and delusions of grandeur. Gleaning what meager information they could from murky faxes of an unpublished Pons-Fleischmann paper and from TV pictures of the apparatus, chemists and physicists dropped whatever else they were doing in attempts to verify or shoot down the concept of cold fusion.

GEORGE FREY

The test tube where all the fuss began

Thus began one of the strangest months in the history of science. Hardly a day passed without an announcement from somewhere—Texas, Georgia, Hungary, Brazil, India, the Soviet Union—that at least some parts of the Pons-Fleischmann experiment had been replicated. Scientific protocol went out the window as researchers called press conferences to trumpet the latest results before verifying them.

That turned out to be a dangerous course. The Georgia Institute of Technology, for example, claimed that its team had detected neutrons, a hallmark of fusion reactions, coming from a setup similar to the one Pons and Fleischmann had used. But then the scientists had to retract

the assertion, admitting with embarrassment that they had been misled by a faulty neutron detector. And chemists at Texas A&M, who initially reported significant amounts of excess heat generated by their device, were disappointed when they got less heat in later experiments.

This new phenomenon of science by press conference disturbed many researchers. Said Moshe Gai, a Yale physicist and a member of the Yale-Brookhaven collaboration: "I am dissatisfied and somewhat disappointed with some of my fellow scientists who have done things too much in a hurry." Charles C. Baker, director of fusion research at Argonne National Laboratory, was blunter: "Calling press conferences and making claims of results without having a well-prepared technical report is not the way for a good, professional scientist to function."

Equally offensive to many scientists is the fact that Pons and Fleischmann have steadfastly refused to disclose important details of their work that would enable others to duplicate it. Though they eventually published an account of their experiments in the *Journal of Electroanalytical Chemistry and Interfacial Electrochemistry*, a highly technical Swiss periodical, the paper was too sketchy to be truly enlightening. Pons has argued repeatedly that his critics who are getting negative results do not know how to run the experiment, but he does not show them precisely what they are doing wrong. Declares Keith Thomassen, a physicist who heads one of the fusion-research programs at Lawrence Livermore National Laboratory: "The hard, uncompromising way in which we do our business is that when you make a claim, you present the facts on which you base that claim."

Why is Pons being so cagey? Perhaps because the discovery he and Fleischmann claim to have made could be worth a fortune. Keeping some of the secrets to themselves could serve to protect their financial interests and those of the University of Utah, which has already filed five patent applications, with more to come. Pons insists, though, that he has reached an agreement with Los Alamos National Laboratory to help its scientists replicate his cold-fusion experiments.

FRANK MICELOTTA

Physicist Moshe Gai, right, and an assistant watch over Yale's elaborate experiment

After three weeks there was no evidence that unusual reactions had taken place.

The awesome potential of the alleged discovery explains why so many people are badgering Pons and Fleischmann for information, and why they are giving it out so cautiously. A practical technique for creating useful fusion energy at low temperatures could change the world forever by providing a source of virtually limitless power. Moreover, the process would generate no pollutants—not even carbon dioxide, which many scientists fear is warming the globe in a greenhouse effect. A fusion plant would give off much less radiation than do conventional nuclear-power generators. And it would essentially run on seawater. Any scientist who managed to harness fusion would be guaranteed a Nobel Prize for Physics (and probably Peace as well), untold riches from licensing the process and a place in history alongside Einstein and slightly above Edison. Any scientist who confirmed the claim would get part of the resulting avalanche of research dollars, and anyone who shot it down would gain acclaim within the scientific community.

But the reasons for the fusion furor are more complicated than just the prospects of riches and fame. Scientists and university administrators are sometimes driven by the same sort of base emotions—like jealousy and paranoia—that often motivate less intellectually lofty folks, and the peculiar circumstances of this discovery

A Chronology of Nuclear Confusion

THE FUROR over cold fusion began on March 23, as chem-

SMART—GAMMA/LIAISON

JAMES KEYSER

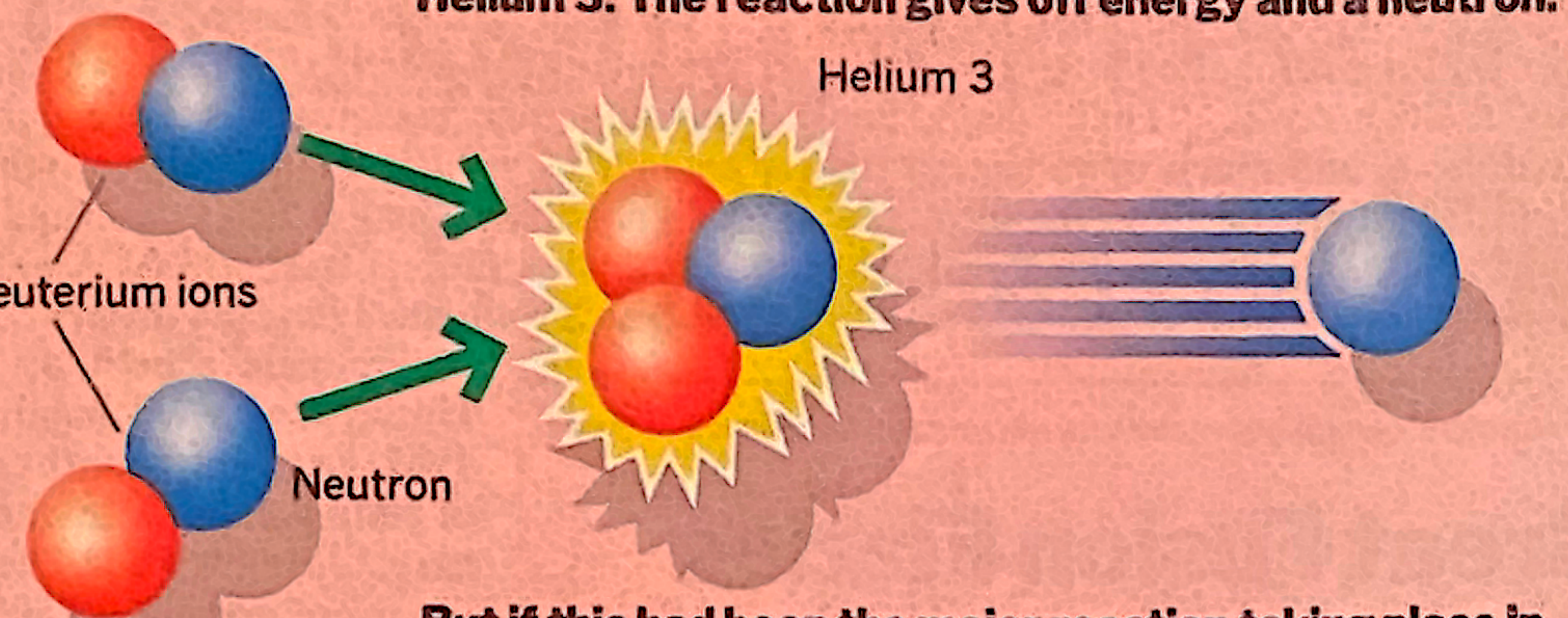
ists B. Stanley Pons and Martin Fleischmann shocked the scientific world with the claim that they had beaten the physicists at their own game. Other scientists were cautious, but Dan Rather dived in headfirst. He led off the CBS *Evening News* that night with a fusion report, gushing about "what may be a tremendous scientific advance." Only a week later, physicist Steven Jones of Brigham Young University announced that he too had been producing cold fusion independently, generating neutrons but not heat. On April 1, two Hungarian scientists said that

LANKES—SYGMA

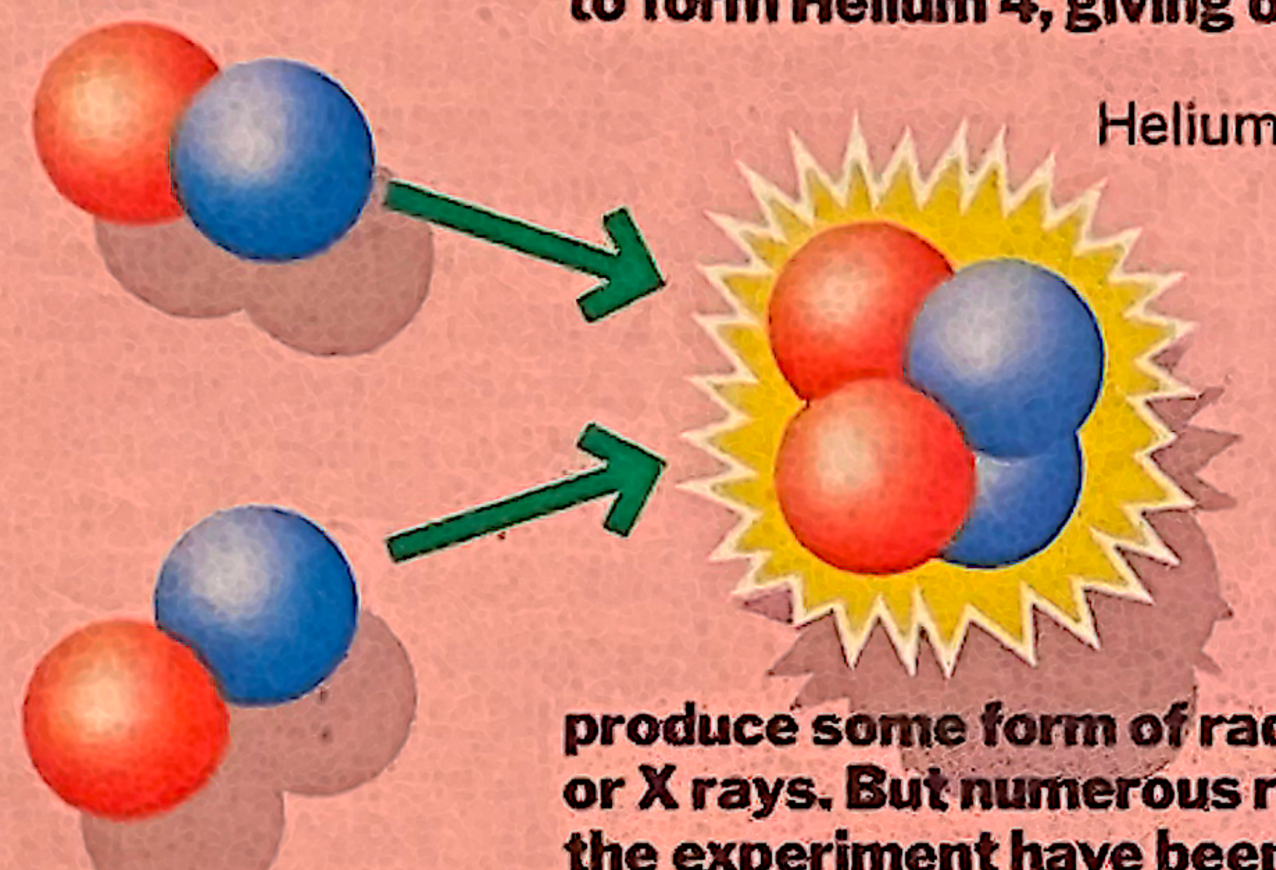
they had produced neutrons as well. Next Texas A&M scientists showed off an experiment on April 10 that they said had confirmed the heat readings re-

MOLECULAR MYSTERY

In one well-known fusion reaction, which is generally believed to occur rapidly only at very high temperatures, two deuterium ions combine to form Helium 3. The reaction gives off energy and a neutron.



But if this had been the major reaction taking place in the Pons-Fleischmann experiment, it would have produced enough neutrons to kill the researchers. Since they survived and detected few neutrons, they believe that a different fusion reaction is occurring. In one variation, the two deuterium ions would combine to form Helium 4, giving off energy but no neutron.



Many scientists doubt that Pons and Fleischmann are right because even unusual types of fusion should produce some form of radiation, perhaps gamma rays or X rays. But numerous researchers trying to repeat the experiment have been unable to detect any significant radiation.

TIME Diagram by Joe Lertola

helped ignite a number of long-smoldering resentments. For one thing, fusion and other subatomic phenomena that are usually studied with giant nuclear reactors and particle accelerators have long been the private domain of physicists. Chemists, on the other hand, were more likely to be studying how to make a better laundry detergent, or so physicists seem to think. It is no surprise, then, that the harshest critics of Pons and his dime-store equipment have been physicists. Retorts Pons: "Chemists are supposed to discover new chemicals. The physicists don't like it when they discover new physicals." In fact, many chemists feel—with much justification—that the physicists consider themselves intellectually superior. Says Cheves Walling, a Utah chemist who has developed one theory to explain how the cold-fusion experiment might work: "Chemists resent the fact that physicists can get money for multimillion-dollar experiments that could have gone to chemists to do something more useful."

Still, the cold-fusion combat is not just the physicists vs. the chemists. There is a sense in Salt Lake City that most of Pons' critics are what Utah chemist David Grant calls "the mean bullies from the Eastern establishment." Such snooty folks should remember, he says, that "science is not the domain of one set of colleges or one set of people anymore."

There is also an intense rivalry between the University of Utah—the U, for short—and Brigham Young University, located just 50 miles away. Although the U is the state-supported university, Utah's majority Mormon population identifies far more strongly with church-run Brigham Young. It was at least partly because a Brigham Young physicist named Steven Jones was nearing an announcement on cold fusion too that Pons and Fleischmann called their surprise press conference. They had been urged to go public by University of Utah administrators, who were apparently fearful that archrivals at Brigham Young would steal the fusion spotlight. The U has had chronic money troubles recently, and an influx of fusion-research grants, not to mention international glory, could go a long way toward remedying the situation.

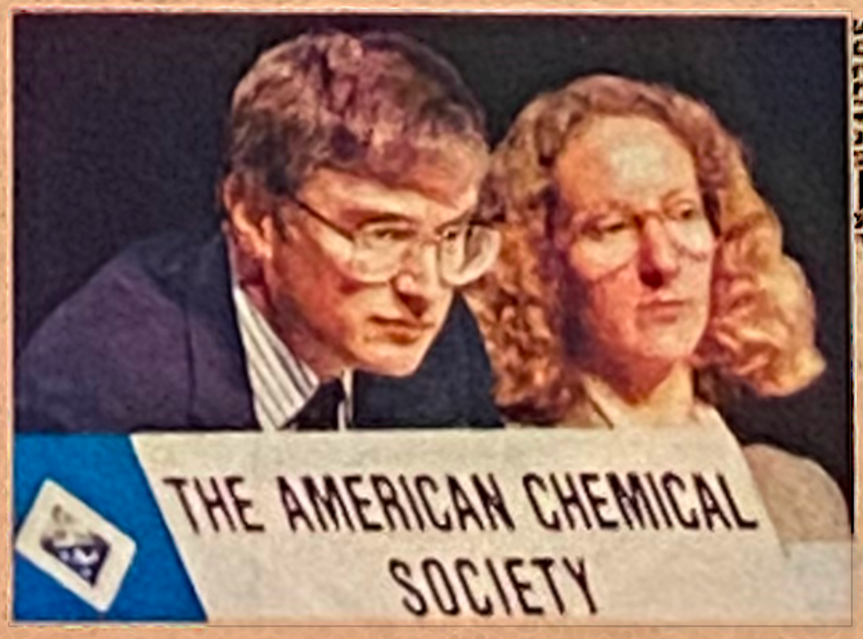
Any serious prospect of practical fusion will attract federal research funding. For decades the Government has spent billions of dollars in pursuit of this tantalizing but elusive goal. The first man-made fusion reactions took the form of H-bomb explosions in the 1950s. Scientists then set out to bring that incredible power under control. Their strategy was to confine deuterium, a heavy form of hydrogen, within a "bottle" of magnetic force and heat it to tens of millions of degrees. The nuclei of the atoms, forced close together despite their mutually repellent positive electric charges, would fuse, releasing energy. Elaborated and modified, that is the approach still being taken at such state-of-the-art facilities as Princeton's Plasma Physics Laboratory. But the lab has achieved only brief bursts of fusion at enormous cost. A more recent concept, represented by Livermore's Nova machine, is to take tiny "marbles" filled with deuterium and concentrate 100 trillion watts of laser light on them for a billionth of a second. The deuterium should theoretically fuse and produce energy, but a far more powerful laser would be needed to spark a useful reaction.

Although superhot fusion has always been considered the best way to generate power, physicists have known since the 1950s that the process can take place at room temperature as well. If the electrons in deuterium are replaced with heavier particles called muons, the deuterium nu-

corded previously by Pons and Fleischmann. Fusion fever was rising now. Georgia Tech said on the same day that its jean-clad researchers had detected

SYKES—SYGMA

neutrons. Maddeningly, no one seemed to be looking for both heat *and* neutrons in a single experiment, to nail down whether fusion was in fact occurring. But Pons showed no doubt on April 12 as he addressed 7,000 members of the American Chemical Society, who had crowded into a basketball arena in Dallas. When he was questioned, it became clear that his paper was sketchy because his technique



SULLIVAN—AP

was sketchy: he and Fleischmann had failed to do elementary control tests before going public. But it was fusion, Pons insisted, not just an unusual chemical reaction, as others had suggested. A Soviet group chimed in that day to say it had found its own neutrons. Indian scientists said the same. And on April 13, two graduate students at the University of Washington announced that they had recorded no neutrons or heat, but did detect other fusion by-products. Pons met the public

clei can approach each other more closely and occasionally fuse on their own. This muon-catalyzed fusion has never produced significant amounts of energy.

Yet the thought that cold fusion was possible at all continued to intrigue some scientists, including Pons and Fleischmann. When Pons got his Ph.D. at Southampton in 1978, Fleischmann was his department head. They became close friends and collaborators after Pons graduated, and remained so when he settled at Utah. One day in 1984 Pons and Fleischmann had a sudden idea for a new way to achieve cold fusion. The brainstorm came, Pons says, during a hike up Millcreek Canyon, near his home in Salt Lake City. He and Fleischmann were puzzling over the peculiar properties of certain metals, like palladium, that are known to absorb huge quantities of hydrogen gas. In the presence of an electric field, the chemists had noticed, deuterium nuclei appeared to be unusually free to move around within palladium's latticework of atoms. They speculated that the nuclei might even come close enough together to make nuclear fusion more likely.

"We came down from the hike," recalls Pons, "and then we stood around the table in my kitchen, had a couple of Jack Daniel's and started drawing pictures." Their experiments resembled nothing more than the simple electrochemical cells often entered in high school science fairs: two metal electrodes immersed in a bath of water laced with mineral salts and connected to a power supply. The only differences were that one of the electrodes was made of palladium and the water was heavy water, or deuterium oxide (chemical formula D_2O), rather than ordinary H_2O.

The first experiments did not do much. But one night in 1985, an electrochemical cell being used by the two scientists melted down. "That," says Pons, "told us we had much more energy than could be attributed to a chemical reaction." After the accident, Pons called Fleischmann, who had returned to England. Fleischmann responded to the momentous news with an admonition: "We'd better not talk on the phone." Pons says they ultimately spent about $100,000 of their own money to pursue what they were convinced was fusion.

Neither Pons nor Fleischmann would have ranked high on anyone's list of scientists likely to revolutionize physics, although both are respected researchers in the field of electrochemistry, the study of how chemical reactions behave in the presence of an electric field. In retrospect, though, their backgrounds were quirky enough to suggest that almost anything was possible. Pons, in particular, had an unorthodox professional history. A native North Carolinian, Pons, 46, dropped out of graduate school at the University of Michigan in 1967, just a few months shy of getting a Ph.D. in chemistry. "Jobs for Ph.D. chemists were paying $3,500 a year at the time," he explains. "My daddy offered me $20,000." He joined the family textile business, then went on to manage a family-owned restaurant in North Palm Beach, Fla. But after nearly a decade away from science, Pons decided to go back and complete his degree. To do so at Michigan, though, he would have had to repeat most of the courses he had already taken. So he went to Southampton, where his credits would still count.

After finishing his doctorate, Pons was able to make up for lost time, becoming chairman of the Utah chemistry department in 1988. Along the way he earned a reputation for diligence and creativity. Says Harry Mark, Pons' adviser at Michigan: "Stan was innovative and controversial even back in grad school. What he's doing now doesn't surprise me."

Fleischmann too is known for resourcefulness. Now 62, he arrived in England in 1939 with his family, Czech refugees from Hitler's Europe, and soon distinguished himself in school and college. Ian Fells, who worked with him at the University of Newcastle, calls him a man of "great ideas," and Roger Parsons, head of the chemistry department at

The Great Fusion Fizzles

Pons and Fleischmann were not the first to suggest they had harnessed the fabled power of fusion. Disappointments in the past:

1926 German scientists Fritz Paneth and Kurt Peters described a way to create fusion with palladium, the same material now used by Pons and Fleischmann. Less than a year later the Germans admitted that they had made procedural errors, and published retractions.

1951 Argentine President Juan Perón declared that his German-trained fusion guru, Ronald Richter, had produced "controlled liberation of atomic energy," using not uranium or plutonium but cheap local materials. "I know what the other material is that the Argentines are using," said one skeptic. "It's baloney." Perón's fusion project was later completely discredited, and Richter was arrested.

1956 U.S. physicist Luis Alvarez reported achieving low-temperature fusion. More research revealed that the reaction was too slow to put out useful energy. He later wistfully recalled the "short but exhilarating experience when we thought we had solved all of the fuel problems of mankind for the rest of time."

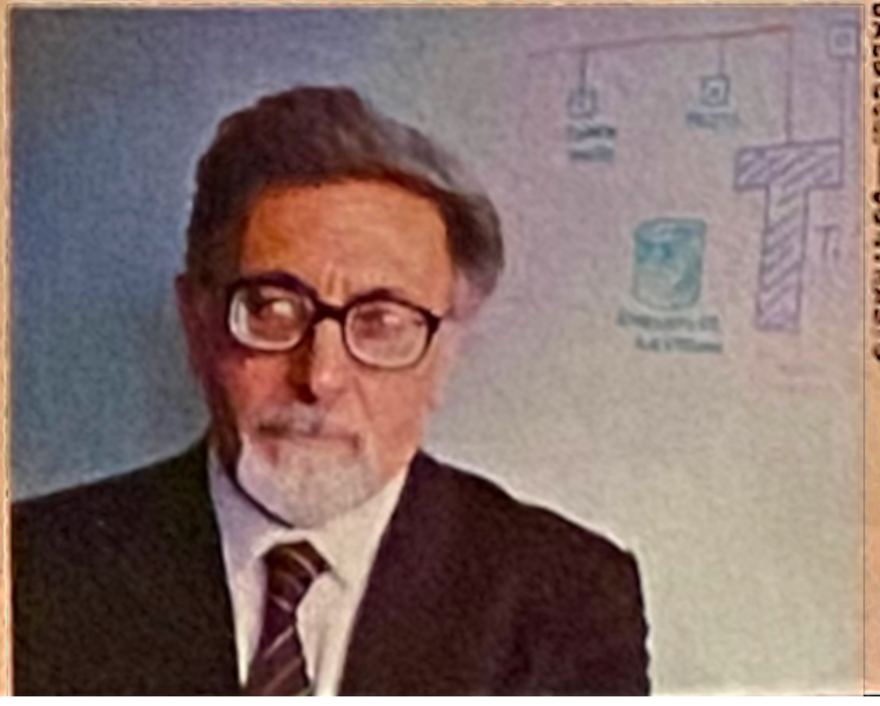
1958 Britain's Sir John Cockcroft announced that he was "90% certain" that his ZETA (for Zero Energy Thermonuclear Assembly) machine had produced a controlled fusion reaction. THE MIGHTY ZETA, screamed the London *Daily Mail*; LIMITLESS FUEL FOR MILLIONS OF YEARS. But while ZETA generated big dreams, it never yielded more than small amounts of energy.

again on April 17, at a press conference, to say there were some 30 institutions that had confirmed his results but were

GEORGE FREY

RON GRANT TUSSY

reluctant to go public with the information, in part "for legal reasons." But Robert Huggins, a Stanford materials scientist, had no legal qualms. He reported excess heat from a cold-fusion device tucked into a red picnic cooler. Because he performed a control experiment to rule out a conventional chemical reaction, this was the strongest confirmation yet. The next day, Francesco Scaramuzzi, a bearded physicist with the Italian National Agency for Nuclear and Alternative Energy, reported what has been dubbed "Frascati fusion," for the town near Rome where his team detected the neutron signature of cold fusion. This, plus other announcements from India and South America, was



BALDELLI—CONTRASTO

Southampton, describes Fleischmann as "excitable in the sense that he gets very enthusiastic about ideas. He is a man full of ideas across a wide field and not necessarily connected to his main research."

By 1988, Pons and Fleischmann were focusing much of their attention on the quest for cold fusion. But they were not alone. At Brigham Young, a team headed by physicist Steven Jones had been working on a similar experiment for at least two years. Jones had also found evidence of fusion, but did not get the excess heat production that Pons and Fleischmann were observing. The two groups were evidently unaware of each other until last September, when Jones was asked to review a Pons-Fleischmann grant application. To his surprise, Jones says, he realized that he and the Utah researchers were following parallel paths. He made contact with Pons and suggested that the unwitting competitors should collaborate.

That eventually led to a showdown meeting on March 6 at which, according to a Brigham Young document, the scientists and top administrators from both universities were present. At issue was the timing of public statements. Pons and Fleischmann said they would prefer to wait before releasing results. Jones countered that he had been invited to talk about his work before the American Physical Society in May and that he intended to do so. According to Brigham Young, the meeting ended with an agreement to submit simultaneous papers to *Nature* on March 24. When Pons and Fleischmann suddenly announced their "breakthrough" on March 23, Jones felt he had been sandbagged.

The race with Jones appears to have forced Pons and Fleischmann to go public long before they were ready. Their paper on cold fusion is considered less—far less—than rigorous. "Every great discovery has had plenty of skeptics," notes Richard Muller, a physicist at Lawrence Berkeley Laboratory, "but I can't find any great discovery of the past 50 years that was published with a bad paper. If a freshman physics or chemistry major had done it, they would have flunked." Says Robert G. Sachs, former director of Argonne National Laboratory: "It doesn't meet the kind of standards you'd want to meet for nuclear physics. It doesn't even meet the standards of testing in inorganic chemistry. It's a shame. They obviously just got too excited about it to think straight."

Nature asked for more information from Pons and Fleischmann before publishing the paper, but according to the journal the pair said they were too busy. Fleischmann, though, claims they supplied 19 new pages. In any case, the paper was withdrawn. Says Fleischmann: "*Nature* is not the appropriate place to publish because they don't publish full papers." That peculiar sentiment might come as a surprise to James Watson and Francis Crick, whose Nobel-prizewinning discovery of the structure of DNA was first published in the British journal.

None of the criticisms leveled at Pons and Fleischmann mean that they are necessarily wrong. But the burden of proof remains on them. So far, they have failed to demonstrate convincingly that they have indeed produced a new sort of fusion. And if the two chemists cannot think of any way to explain the excess heat in their experiment without resorting to nuclear reactions, others can. Chemist Linus Pauling, a Nobel laureate and himself something of an iconoclast, thinks that when absorbing high concentrations of deuterium, the palladium lattice may become unstable and deteriorate, releasing heat.

Even if Pons and Fleischmann should turn out to be right, the world's energy problems are not necessarily over. As the proponents of more conventional fusion research have learned, transforming a reaction from a laboratory curiosity to a full-scale energy technology can be incredibly difficult. Magnetic fusion has yet to achieve break-even, the stage at which the amount of energy coming out is equal to that going in. Says Harold Furth, director of Princeton's effort: "We are essentially within a factor of two of break-even now. Seeing that it used to be a factor of a million, we feel extremely optimistic." But it has taken more than 30 years to get there, and plenty of technical problems remain.

In short, no matter which scheme proves best, the virtually limitless power that could eventually result from fusion is a dream that will not come true anytime soon. The solution to the world's energy crisis is not likely to be declared in a press conference. It must be slowly and carefully worked out, step by painstaking step. ***—Reported by David Bjerklie/New York, J. Madeleine Nash/San Francisco and Dick Thompson/Washington***


PETER MENZEL

The powerful Nova laser at Lawrence Livermore National Laboratory

At 100 trillion watts, it is still too weak to get the job done.

SYKES—SYGMA

beginning to give the doubters pause. Then, on April 25, the tide turned. Georgia Tech, having hastily withdrawn its fusion results the previous week for fear that its equipment was bad, made the reversal official. "I don't think fusion occurred," said embarrassed team leader James Mahaffey. There was worse news to come. The collaboration between Brookhaven National Laboratory and Yale, using an array of the most sophisticated equipment available, concluded its tests of cold fusion and found nothing. No other national lab had done any better. And on April 27, the British journal *Nature*, to which Pons and Fleischmann had submitted their paper, then withdrawn it when asked to give more information, published an editorial on fusion fever. Verdict: it had been fun, but Pons and Fleischmann had been sloppy. Cold fusion, editor John Maddox bet, would most likely be a flop.


FRANK MICELOTTA

nature
INTERNATIONAL WEEKLY JOURNAL OF SCIENCE

Two-pronged attack: ten-man crews hose down the shore, while "skimming" vessels remove the remaining oil from the sea

Nature Aids the Alaska Cleanup

Despite disappointing progress, hope is in the air

BY JORDAN BONFANTE

When breaks in the stormy weather permit, cleanup crews in a bay of Alaska's Eleanor Island come ashore in landing craft meant for infantry assaults. Off Kenai Peninsula, 200 miles away, the 425-ft. Soviet ship *Vaydaghubsky* stalks chocolate-colored oil on the high seas. At the top of Montague Strait, south of Valdez harbor, the 17,000-ton troopship U.S.S. *Juneau* has set anchor. The 400 men aboard are on an expedition to cleanse oil-stricken Smith Island before the annual arrival of seals.

A month after the *Exxon Valdez* disgorged 11 million gallons of crude oil into Alaska's Prince William Sound, the effort to combat the worst such spill in U.S. history assumed the tempo of a military operation. By last week Exxon alone had mobilized 460 vessels, 26 aircraft and the first 2,850 members of what is expected to be a 4,000-person cleanup brigade. Said a company executive: "We could invade a small country with what we have deployed here."

For all the show of force, however, the recovery drive has made little tangible progress. Exxon estimated that it had cleaned a scant 3,300 ft. of beach, leaving 304 miles of oil-covered shoreline to go in Prince William Sound alone. The company claimed that it would pick up the remaining seaborne oil within the next two weeks and scrub all the fouled shoreline before cold weather arrives in September. But Alaskan officials grimaced with skepticism. "Sounds too rosy," said Dennis Kelso, Alaska's environmental conservation commissioner. "Look at Exxon's track record till now—too little, too late, and too many excuses."

Fortunately, nature itself, in fits and starts, seemed to be coming to the rescue. Four days of rain and snowstorms last week helped break up the floating oil and cleanse a number of shores. Moreover, the coming of the long spring and summer thaw is sure to create a rush of rivulets and waterfalls that will help wash off the shoreline. Observed John Robinson, of the National Oceanic and Atmospheric Administration: "In the end, nature has to do this job."

The job will be enormous. By last week the oil slick had traveled across an 1,800-sq.-mi. area. To stop its advance, "skimming" vessels sucked up the crude for transfer to dredging barges. Onshore, ten-man crews hosed down rocks with heated seawater. The two-pronged drive to clear sea and shore was plagued by snafus and logistical problems. As the weathered oil hardened into a debris-laden "mousse," the Soviet skimming ship found that the crude was too thick for its pumps and managed to recover only a few hundred barrels. And as the point of the oil slick advanced, it stretched supply lines farther and farther from the Valdez staging base. Without proper floating barriers to protect their harbor, fishermen in the village of Seldovia had to fashion their own out of logs, tarpaulins, sheets and towels.

While cleanup crews battled the slick, the toll on Alaskan wildlife continued to mount. The body count of 458 fallen otters and 2,889 dead birds represented only a fraction of the casualties. Up to 2,000 otters may have perished. More than 33,000 birds may have died in Prince William Sound alone. To save the 6.5 million sandpipers and 10 million other shorebirds starting to migrate through the region, wildlife experts are trying to scare them away from their favorite stopping-off sites. The naturalists have set up big-barreled propane-powered cannons that are timed to go off noisily at regular intervals. They even erected 37 scarecrows dressed in Salvation Army clothing.

The impact on fishing has been crippling. After tests showed possible contamination, Alaskan authorities canceled the fishing seasons for herring, herring roe and pot shrimp throughout Prince William Sound. The salmon season, due to start in mid-May, remains in doubt. "Sure, Exxon may pay in the end," fumed Sandy Cesarini, co-owner of the Sea Hawk Seafood Co. in Valdez. "But we sweated blood to build this place. What about the future? Everyone in the sound feels violated."

The long-term effect on fish and other wildlife is difficult to gauge. Nobody knows how much oil may be sinking to the seabed, for instance. One hopeful note was sounded by the National Marine Fisheries Service in Juneau. Tests showed that salmon eggs and crab larvae, at least, may have escaped contamination because the oil became diluted and degraded to nontoxic levels before those organisms were exposed to it.

In the village of Cordova, 500 fishermen and townspeople stood at the waterfront in a driving rain and staged a "requiem" for Prince William Sound. State environment commissioner Kelso, on hand to address the group, tried to ease the sense of gloom. He recounted to the throng that on a recent inspection trip to Knight Island he had seen a great pod of whales offshore. There were as many as 40, so close that he could hear the sound of their exhalations when they surfaced and the slap of their flukes when they dived once more. Seeing how the huge sea mammals were skirting the oil but not fleeing the area gave Kelso new optimism about Alaska's ability to recover. Said he: "I realized that there is hope." ■